CLAIMS

1. A support (1) installed at sea, in grounded or floating manner (1-2, 1-1), said support being fitted on its surface with a storage and guide device (4) for storing and guiding flexible pipes (3, 3a-3b-3c) and suitable for storing and guiding a plurality of said flexible pipes, and preferably at least three of them, the support being characterized in that the storage and guide device comprises:

· a first carrier structure (5) resting on or secured to the deck (1c) of said support (1) close to a side (1d) of said support (1), preferably a longitudinal end wall of said support, said first carrier structure (5) supporting a plurality of circular turntables (4-1) arranged one above another;

· each of said turntables (4-1, 4a, 4b, 4c) being suitable for being driven in rotation in powered manner by a first motor (6) about a vertical central axis ZZ' independently of one another, preferably about the same vertical central axis ZZ', each turntable having a central orifice (4-2) surmounted by a central cylinder (4-3) against and around which a said flexible pipe (3, 3a, 3b, 3c) can be wound in concentric juxtaposed spiral turns of increasing diameter resting on the top face (4-1a) of said turntable, said central orifice (4-2) of said turntable being fitted with a rotary joint coupling (7) suitable for providing coupling between firstly a first end (3-1) that is closest to said central cylinder of a flexible pipe wound around said flexible cylinder, said first pipe end (3-1) being suitable for being driven in rotation together with said turntable, and secondly an end (8-1) of a stationary transfer pipe (8) having its other end in communication with at least one first tank (11) within said support (1); and

· a plurality of guide means (10, 10a, 10b, 10c), each said guide means being suitable for guiding the portion (3-2) of said pipe leaving a respective one of

each of said turntables in continuity with the portion of pipe wound on said turntable, in such a manner that the various said pipe portions (3-2) leaving the various turntables are arranged in straight lines, being offset in different positions along a horizontal direction $Y_1Y'_1$ parallel to said side, at different heights, and capable of adopting different orientations ($\alpha 1$, $\alpha 2$, $\alpha 3$) for their vertical axial planes (P1, P2, P3) relative to said horizontal direction Y_1Y_1' parallel to said side (1d).

2. A support (1) according to claim 1, characterized in that at least one said flexible pipe (3) is wound against and around a said central cylinder (4-3) in concentric juxtaposed spiral turns of increasing diameters resting on said turntable (4-1), said central cylinder presenting a radius greater than the minimum radius of curvature of said flexible pipe, there being preferably at least three flexible pipes wound respectively on at least three said turntables, including at least one flexible pipe of diameter smaller than the others.

3. A support (1) according to claim 1 or claim 2, characterized in that each guide means is arranged at a different height facing a respective one of each of said turntables so as to be suitable for supporting an intermediate curved pipe portion (3-3) between a downstream portion (3-4) of said pipe in a substantially vertical position beside said side (1d) and a said upstream pipe portion leaving the turntable (3-2) in continuity with the wound pipe portion resting on a said turntable, said upstream pipe portion (3-2) leaving the turntable extending on a virtual plane P that is substantially tangential to the surface of the top face (4-1a) of said turntable on which said wound pipe portion is wound, the various downstream pipe portions (4-4) in substantially vertical positions beside said side being arranged in positions that are offset relative to one

another in a said direction Y_2Y_2' parallel to said side on leaving said sheaves.

4. A support according to claim 3, characterized in that each said guide means (10) comprises a sheave (10-1) mounted to revolve about a horizontal first axis of rotation Y_1Y_1', said sheave also being suitable for swiveling, preferably freely, about a vertical second axis of rotation Z_1Z_1' extending along a diameter of the sheave, said first axis of rotation about which each said sheave revolves preferably being controlled by a second motor (10-6), preferably synchronously with said first motor (6) of each said turntable (4-1).

5. A support (1) according to claim 4, characterized in that the various sheaves (10a, 10b, 10c) are arranged offset side by side relative to one another in said horizontal direction $Y_1Y'_1$ parallel to said side at different heights, the top of each sheave preferably being positioned substantially level with a plane P tangential to the top face (4-1a) of a said turntable (4-1).

6. A support according to claim 5, characterized in that each sheave is supported by a second carrier structure (10-2) arranged outside said support and fastened to a common side (1d) at a different position in a said horizontal direction Y_1Y_1' parallel to said side, each sheave being mounted to swivel about said vertical second axis of rotation Z_1Z_1' relative to a portion (10-4, 10-5) of its said second carrier structure fastened to said side (1d).

7. A support (1) according to any one of claims 1 to 6, characterized in that each said turntable (4-1) includes or co-operates on its under face with wheels (4-5) suitable for co-operating with or respectively supported

by elements (5a) of said carrier structure, and each said turntable including a bearing (4-4) at said central orifice, the bearing being secured to said carrier structure (5) and being suitable for enabling said turntable to rotate relative to said first carrier structure (5).

8. A support (1) according to any one of claims 1 to 7, characterized in that at least one said turntable (4-1d) presents a top face (4-1a) that is plane and horizontal.

9. A support (1) according to any one of claims 1 to 7, characterized in that at least one said turntable (4-1c) presents a top face of convex frustoconical shape, with an angle γ at the apex preferably lying in the range 160° to 178°.

10. A support (1) according to any one of claims 1 to 7, characterized in that at least one said turntable (4-1b) presents a top face (4-1a) of concave frustoconical shape, with an angle γ at the apex preferably lying in the range 160° to 178°.

11. A support (1) according to any one of claims 1 to 10, characterized in that it is fitted with a plurality, n, of flexible pipes (3a, 3b, 3c) each co-operating at its said first end (3-1) with a respective said turntable, said flexible pipes being connected together at their second ends (3-6) by a first connection and valve device (13-1) having n preferably rigid first pipe portions (21a, 21b, 21c) held in preferably parallel fixed positions relative to one another, n being an integer not less than 3, each said first pipe portion (21a, 21b, 21c) comprising:

- at a first end, a first pipe coupling element (23-1a, 23-1b, 23-1c), preferably a male or female portion of an automatic connector);

· at its second end, a second coupling element, preferably a flange, assembled to the second end (3-6) of a said flexible pipe;

· each said first pipe portion (21a, 21b, 21c) including, between its two ends n-1 branch connections (30) enabling it to communicate with respective ones of the n-1 other said first rigid pipe portions, each said branch connection (30) including a first communication valve (30ab, 30bc, 30ac);

· a first connection valve (22a, 22b, 22c) situated between said first coupling element (23-1a, 23-1b, 23-1c) and said branch connection (30);

· said first pipe portions preferably being held parallel by a first rigid support (24) to which they are secured; and

· said first communication valves (30ab, 30ac, 30bc) preferably being butterfly valves and said first connection valves (22a, 22b, 22c) preferably being ball valves.

12. A support (1) according to claim 11, characterized in that said flexible pipes extend or are suitable for extending between said support (1) and a ship (2), preferably of the methane tanker type, arranged alongside said support (1, 1-1, 1-2) or in tandem facing said side (1d), and said first connection and valve device (13-1) is connected to a second connection and valve device (13-2) arranged or suitable for being arranged on board said preferably methane tanker type ship (2), said second connection and valve device (13-2) comprising:

· n preferably rigid second pipe portions (26a, 26b, 26c);

· each said second pipe portion (26a, 26b, 26c) communicating at one of its ends with a said second tank (12) and including at its other end a first complementary pipe coupling element (23-2a, 23-2b, 23-2c), said first complementary coupling element being suitable for co-

operating in reversible coupling (23) with a said first coupling element (23-1a, 23-1b, 23-1c), said first complementary coupling element preferably being a female or male automatic connector portion (23-2a, 23-2b, 23-2c), respectively;

· said second pipe portions (26a, 26b, 26c) being held in preferably parallel fixed positions relative to one another so as to enable said first complementary coupling element (23-2a, 23-2b, 23-2c) to be coupled with said first coupling element (23-1a, 23-1b, 23-1c);

· each said second pipe portion (26a, 26b, 26c) having a second connection valve (27a, 27b, 27c) suitable for allowing or preventing fluid from flowing in said second pipe portion towards or from said first complementary coupling element when open or closed, respectively;

· said second pipe portions preferably being held parallel to one another by a second rigid support (25) to which they are secured; and

· said second connection valves (27a, 27b, 27c) preferably being ball valves.

13. A method of transferring a liquid or gaseous petroleum fluid, wherein a said petroleum fluid is transferred via at least two flexible pipes (3), preferably via at least three flexible pipes (3a, 3b, 3c), extending between a said support (1) according to any one of claims 1 to 12 and a ship (2), preferably of the methane tanker type, arranged alongside or in tandem adjacent to said floating support (1) facing said side (1d), said flexible pipes (3) being guided with the help of a said storage and guide device (4).

14. A method according to claim 13, characterized in that said flexible pipes are floating pipes, floating on the surface over a fraction (3-5) of the distance between

said support (1) and said ship (2), preferably of the methane tanker type.

15. A method according to claim 13 or claim 14, characterized in that use is made of at least one flexible pipe, a "first" flexible pipe, preferably of at least two flexible pipes, "first" and "second" flexible pipes (3b, 3c), within which liquefied gas is transferred between said floating support and at least one second tank (12) of said ship (2), preferably of the methane tanker tank, and of a third flexible pipe (3a), preferably of diameter smaller than the diameter of said first and second flexible pipes, within which gas corresponding to the gas ceiling of the second tank is transferred between a said second tank (12) to a first tank within said floating support or to a liquefaction unit (1b) on a said support prior to being transferred to a said first tank (11).

16. A method according to any one of claims 13 to 15, characterized in that said flexible pipes are fitted with a first connection and valve device (13-1) as defined in claim 11 and connected to a said second connection and valve device (13-2) as defined in claim 12, said flexible pipes preferably being floating flexible pipes, and said floating flexible pipes (3b, 3c) that have been used for transferring liquid natural gas LNG from said support (1) to a said ship (2), preferably of the methane tanker type, are purged by performing the following successive steps:

a. closing said first and second connection valves (22a-22b-22c, 27a-27b-27c), and disconnecting said first and second connection and valve devices (13-1, 13-2) from each other;

b. injecting gas into the first end (3-1) of a first flexible pipe (3b) from said support (1) and opening at least one said first communication valve (30bc) between

said first flexible pipe (3b) and a second flexible pipe (3c) assembled to the same said first connection and valve device (13-1), the other said first communication valves (30ac, 30ab) being closed; and then

c. closing said first communication valve (30bc) between said first and second flexible pipes (3b, 3c) when said first pipe (3b) has been emptied sufficiently, and preferably substantially completely emptied.

17. A method according to claim 16, characterized in that after step c), said second pipe (3c) is purged completely by performing the following successive steps:

d. injecting gas from the support (1) into said first end (3-1) of said second pipe (3c) and opening said first communication valve (30ac) between said second pipe (3c) and a third flexible pipe (3a) of smaller diameter than said second pipe so that the flow rate of purge gas is such that the speed of said gas is greater than 1.5 m/s, preferably greater than 3 m/s, more preferably greater than 5 m/s, said other first communication valves (30ab, 30bc) being closed; and

e. closing said first communication valve (30ac) between said second and third pipes (3c, 3a) when said second pipe (3c) has been emptied sufficiently, and preferably emptied substantially completely.

18. A method according to claim 16 or claim 17, characterized in that when all of said flexible pipes have been purged sufficiently, said flexible pipes are rewound onto their said turntables until the second ends (3-6) of all of said flexible pipes are above water, preferably with said first connection and valve device (13-1) coming just under the lowest of the turntables co-operating with one of said flexible pipes.

19. A method according to claim 18, characterized in that said first pipe (3b) is wound on a said convex turntable as defined in claim 9.

20. A method according to claim 18 or claim 19, characterized in that at least one of said second and third flexible pipes (3c, 3a) used for transporting liquid, and preferably both of said second and third flexible pipes (3c, 3a) used for transporting liquid, is (or are) wound on a said frustoconical turntable of concave shape as defined in claim 10.

CLAIMS:

1. A support installed at sea, in grounded or floating manner, said support being fitted on its surface with a storage and guide device for storing and guiding flexible pipes and suitable for storing and guiding a plurality of said flexible pipes, wherein the storage and guide device comprises:

· a first carrier structure resting on or secured to the deck of said support close to a side of said support, said first carrier structure supporting a plurality of circular turntables arranged one above another;

· each of said turntables being suitable for being driven in rotation in powered manner by a first motor about a vertical central axis ZZ' independently of one another, each turntable having a central orifice surmounted by a central cylinder against and around which a said flexible pipe can be wound in concentric juxtaposed spiral turns of increasing diameter resting on the top face of said turntable, said central orifice of said turntable being fitted with a rotary joint coupling suitable for providing coupling between firstly a first end that is closest to said central cylinder of a flexible pipe wound around said flexible cylinder, said first end being suitable for being driven in rotation together with said turntable, and secondly an end of a stationary transfer pipe having its other end in communication with at least one first tank within said support; and

· a plurality of guide means, each said guide means being suitable for guiding the portion of said flexible pipe leaving a respective one of each of said turntables in continuity with the portion of pipe wound on said turntable, in such a manner that the various said pipe portions leaving the various turntables are arranged in straight lines, being offset in different positions along a horizontal direction $Y_1Y'_1$ parallel to said side, at

different heights, and capable of adopting different orientations for their vertical axial planes relative to said horizontal direction Y_1Y_1' parallel to said side.

2. A support according to claim 1, wherein the storage and guide device is suitable for storing and guiding at least three of said flexible pipes, and each of said turntables is suitable for rotation about the same vertical central axis ZZ'.

3. A support according to claim 1 or claim 2, wherein at least one said flexible pipe is wound against and around a said central cylinder in concentric juxtaposed spiral turns of increasing diameters resting on said turntable, said central cylinder presenting a radius greater than the minimum radius of curvature of said flexible pipe.

4. A support according to any one of claims 1 to 3, wherein each guide means is arranged at a different height facing a respective one of each of said turntables so as to be suitable for supporting an intermediate curved pipe portion between a downstream portion of said flexible pipe in a substantially vertical position beside said side and a said upstream pipe portion leaving the turntable in continuity with the wound pipe portion resting on a said turntable, said upstream pipe portion leaving the turntable extending on a virtual plane P that is substantially tangential to the surface of the top face of said turntable on which said wound pipe portion is wound, the various downstream pipe portions in substantially vertical positions beside said side being arranged in positions that are offset relative to one another in a said direction Y_2Y_2' parallel to a side on leaving sheaves.

5. A support according to claim 4, wherein each said guide means comprises a sheave mounted to revolve about a

horizontal first axis of rotation Y_1Y_1', said sheave also being suitable for swiveling, about a vertical second axis of rotation Z_1Z_1' extending along a diameter of the sheave, said first axis of rotation about which each said sheave revolves being controlled by a second motor .

6. A support according to claim 5, wherein the various sheaves are arranged offset side by side relative to one another in said horizontal direction $Y_1Y'_1$ parallel to said side at different heights, the top of each sheave being positioned substantially level with a plane P tangential to the top face of a said turntable.

7. A support according to claim 6, wherein each sheave is supported by a second carrier structure arranged outside said support and fastened to a common side at a different position in a said horizontal direction Y_1Y_1' parallel to said side, each sheave being mounted to swivel about said vertical second axis of rotation Z_1Z_1' relative to a portion of its said second carrier structure fastened to said side.

8. A support according to any one of claims 1 to 7, wherein each said turntable includes or co-operates on its under face with wheels suitable for co-operating with or respectively supported by elements of said first carrier structure, and each said turntable including a bearing at said central orifice, the bearing being secured to said first carrier structure and being suitable for enabling said turntable to rotate relative to said first carrier structure.

9. A support according to any one of claims 1 to 8, wherein at least one said turntable presents a top face that is plane and horizontal.

10. A support according to any one of claims 1 to 8, wherein at least one said turntable presents a top face of convex frustoconical shape, with an angle γ at the apex lying in the range 160° to 178°.

11. A support according to any one of claims 1 to 6, wherein at least one said turntable presents a top face of concave frustoconical shape, with an angle γ at the apex lying in the range 160° to 178°.

12. A support according to any one of claims 1 to 11, wherein it is fitted with n flexible pipes each co-operating at its said first end with a respective said turntable, said flexible pipes being connected together at their second ends by a first connection and valve device having n rigid first pipe portions held in parallel fixed positions relative to one another, n being an integer not less than 3, each said first pipe portion comprising:

· at a first end, a first pipe coupling element, which is a male or female portion of an automatic connector;

· at its second end, a second coupling element, which is a flange, assembled to the second end of a said flexible pipe;

· each said first pipe portion including, between its two ends n-1 branch connections enabling it to communicate with respective ones of the n-1 other said first rigid pipe portions, each said branch connection including a first communication valve;

· a first connection valve situated between said first pipe coupling element and said branch connection;

· said first pipe portions being held parallel by a first rigid support to which they are secured; and

· said first communication valves being butterfly valves and said first connection valves being ball valves.

13. A support according to claim 12, wherein said flexible pipes extend or are suitable for extending between said support and a ship of the methane tanker type, arranged alongside said support or in tandem facing said side, and said first connection and valve device is connected to a second connection and valve device arranged or suitable for being arranged on board said methane tanker type ship, said second connection and valve device comprising:

· n rigid second pipe portions;

· each said second pipe portion communicating at one of its ends with a second tank and including at its other end a first complementary pipe coupling element, said first complementary pipe coupling element being suitable for co-operating in reversible coupling with a said first pipe coupling element, said first complementary pipe coupling element being a female or male automatic connector portion, respectively;

· said second pipe portions being held in parallel fixed positions relative to one another so as to enable said first complementary pipe coupling element to be coupled with said first pipe coupling element;

· each said second pipe portion having a second connection valve suitable for allowing or preventing fluid from flowing in said second pipe portion towards or from said first complementary pipe coupling element when open or closed, respectively;

· said second pipe portions being held parallel to one another by a second rigid support to which they are secured; and

· said second connection valves being ball valves.

14. A method of transferring a liquid or gaseous petroleum fluid, wherein a said petroleum fluid is transferred via at least two flexible pipes extending between a said support according to any one of claims 1

to 13 and a ship of the methane tanker type, arranged alongside or in tandem adjacent to said floating support facing said side, said flexible pipes being guided with the help of a said storage and guide device.

15. A method according to claim 14, wherein said flexible pipes are floating pipes, floating on the surface over a fraction of the distance between said support and said ship, of the methane tanker type.

16. A method according to claim 14 or 15, wherein use is made of at least two flexible pipes, first and second flexible pipes, within which liquefied gas is transferred between said floating support and at least one second tank of said ship, of the methane tanker tank, and of a third flexible pipe, of diameter smaller than the diameter of said first and second flexible pipes, within which gas corresponding to the gas ceiling of the second tank is transferred between a said second tank to a first tank within said floating support or to a liquefaction unit on a said support prior to being transferred to a said first tank.

17. A method according to any one of claims 14 to 16, wherein said flexible pipes are fitted with a first connection and valve device as defined in claim 12 and connected to a said second connection and valve device as defined in claim 13, said flexible pipes being floating flexible pipes, and said floating flexible pipes that have been used for transferring liquid natural gas LNG from said support to a said ship of the methane tanker type, are purged by performing the following successive steps:

a. closing said first and second connection valves, and disconnecting said first and second connection and valve devices from each other;

b. injecting gas into the first end of a first flexible pipe from said support and opening at least one said first communication valve between said first flexible pipe and a second flexible pipe assembled to the same said first connection and valve device, the other said first communication valves being closed; and then

c. closing said first communication valve between said first and second flexible pipes when said first flexible pipe has been emptied sufficiently.

18. A method according to claim 17, wherein in the step c, closing said first communication valve between said first and second flexible pipes when said first flexible pipe has been substantially completely emptied.

19. A method according to claim 17 or 18, wherein after step c), said second flexible pipe is purged completely by performing the following successive steps:

d. injecting gas from the support into said first end of said second flexible pipe and opening said first communication valve between said second flexible pipe and a third flexible pipe of smaller diameter than said second flexible pipe so that the flow rate of purge gas is such that the speed of said gas is greater than 1.5 m/s, said other first communication valves being closed; and

e. closing said first communication valve between said second and third flexible pipes when said second flexible pipe has been emptied sufficiently.

20. A method according to claim anyone of claims 14 to 19, wherein said first flexible pipe is wound on a said convex turntable as defined in claim 10 and at least one of said second and third flexible pipes used for transporting liquid is wound on a said frustoconical turntable of concave shape as defined in claim 11.